JAN DAVID-ANDERSEN

DIESEL Motor

for

MODELL-FLY, BÂT og BIL.

Diesel Motors

For Model Aircraft, Boats and Cars

HARALD LYCHE & COS FORLAG
DRAMMEN

Author's comments to the 2014 English edition

Adrian Duncan contacted me from Canada earlier this year to ask if he could include an English version of the book that I published in 1945 on his internet pages. I was glad to hear that there are still people who are fascinated by old model engines and their pioneering history.

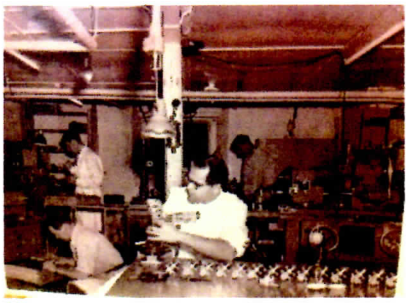
I wrote the original book when I was in my early twenties. At the time, I was experimenting with the design and production of my first model engine. This was during the war, when I only had some access to a Hamilton lathe in my father's jewelry tool-room, with little other equipment.

In 1948 I established my own workshop, and from then until 1964 I produced and sold about 25,000 model engines. The workshop was staffed by myself together with between 4 and 6 employees. My wife began to participate a few years later, handling all the accounting.

The engines were sold in Norway, Sweden, Finland, England and the USA. The retail price for a 2.5cc engine in the hobby shops was roughly NOK 100 (~ UK £5), and I received about half of this amount as the wholesale price.

Today at the age of 93, I still have a workshop, and what used to be my profession is now my hobby. I constantly challenge my previous designs, trying to come up with improvements. Today I do not have the same restrictions with equipment that I did when I started. When I retired 20 years ago, I moved a selection of equipment and tools home to allow me to continue to produce engines in my residence.

I feel very fortunate to have been able to make a living doing something that I really enjoy. My products were considered good model engines at the time, and therefore I am pleased that Mr. Adrian Duncan will make my book available to English readers. I hope that readers will enjoy and appreciate the book and learn from it how manufacturing and design have changed over the years.



1957 - In the original workshop,

1960 educating a son.

2014 - In my hobby room.

The author

Jan David-Andersen

Jan David-Andersen 19-Oct-2014

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Cover Drawing by Johnny Nilsen
1st edition - 1945

Preface

This is not meant to be an essay on model diesel engines, but rather a collection of the experiences and results that I have arrived at after some years of model diesel building as a hobby. The drawings and methods that are described will of course not be suitable for everyone – much may be simplified and improved, but this will require more tools than most of us have available. The intent is that as much as possible should be amenable to being turned in a lathe. It is impossible to produce an engine without the use of a lathe.

I know that there are other ways than those I have described to make an engine. It has to be decided in each individual case how to proceed, and one has to adapt the methods to the tools that are available.

In addition to a workbench, a grinding wheel is needed for sharpening steel lathe tools. A drilling machine is also handy to have, but a hand-driven drill will do in many cases if you don´t have a drill press. Not all drilling operations are amenable to being done in a lathe. Also some hand tools will be used, but these are often easy to borrow or to buy. The most important things are a good vice, a hacksaw, files, a hammer, pliers, a micrometer and a good quality slide caliper. These latter tools are the most important.

As a guideline for how long it will take to produce an engine, I should mention that I expended about 80 hours for my first engine. This means that it would be possible to produce one engine in about 14 days if one is not otherwise too busy. A skilled turner could probably do it in half that time.

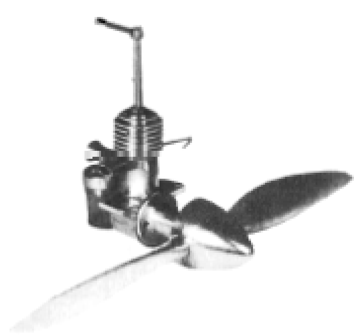
I hope that the engine builder will be pleased with the engine and that he doesn´t encounter too many difficulties in the process. I recommend the book to those who might be interested in it.

Bestun, January 1945

The Author

Diesel Engine

This type of engine is usually called “diesel”, but it is not really what experts call a “diesel”. The model diesel engine works like an ordinary two-stroke petrol engine, with suction into the crankcase and a bypass channel feeding the cylinder. There is no fuel injector. It is not a copy of a full-size engine, like the model petrol engine. The model diesel has a couple of weaknesses, for example the messy exhaust and the fact that it often suffers from slightly erratic running, but otherwise my personal view is that it is the ideal model engine.



How the engine works

1. The piston is in its top position. Two things happen concurrently: combustion on the top of the piston, which will force the piston downwards, and suction under the piston.

2. The piston is in its lowest position. The exhaust gases are discharging through the exhaust pipe and the gases that have been compressed by the downward movement of the piston flow from the crankcase through the bypass channel and fill the cylinder. (Some gas will be lost through the exhaust pipe, but this cannot be avoided in normal two-stroke engines).

The energy that is needed to move the piston back to the top position is delivered by the inertia of the rapidly-rotating propeller. Now, when the piston moves upwards the volume in the crankcase will be increased to create the suction needed to draw fresh gas into the crankcase.

The ratio between the volume in the cylinder when the piston crown is level with the upper edge of the exhaust port and when in its top position is called the compression ratio. In an engine of this type, the compression ratio is around 15:1 to 20:1, depending on the adjustment of the contra piston. *(Editor's note: Jan is using the* ***dynamic*** *compression ratio as his standard here, rather than the more commonly-quoted* ***geometric*** *compression ratio. In doing this, he is undoubtedly more technically correct).*

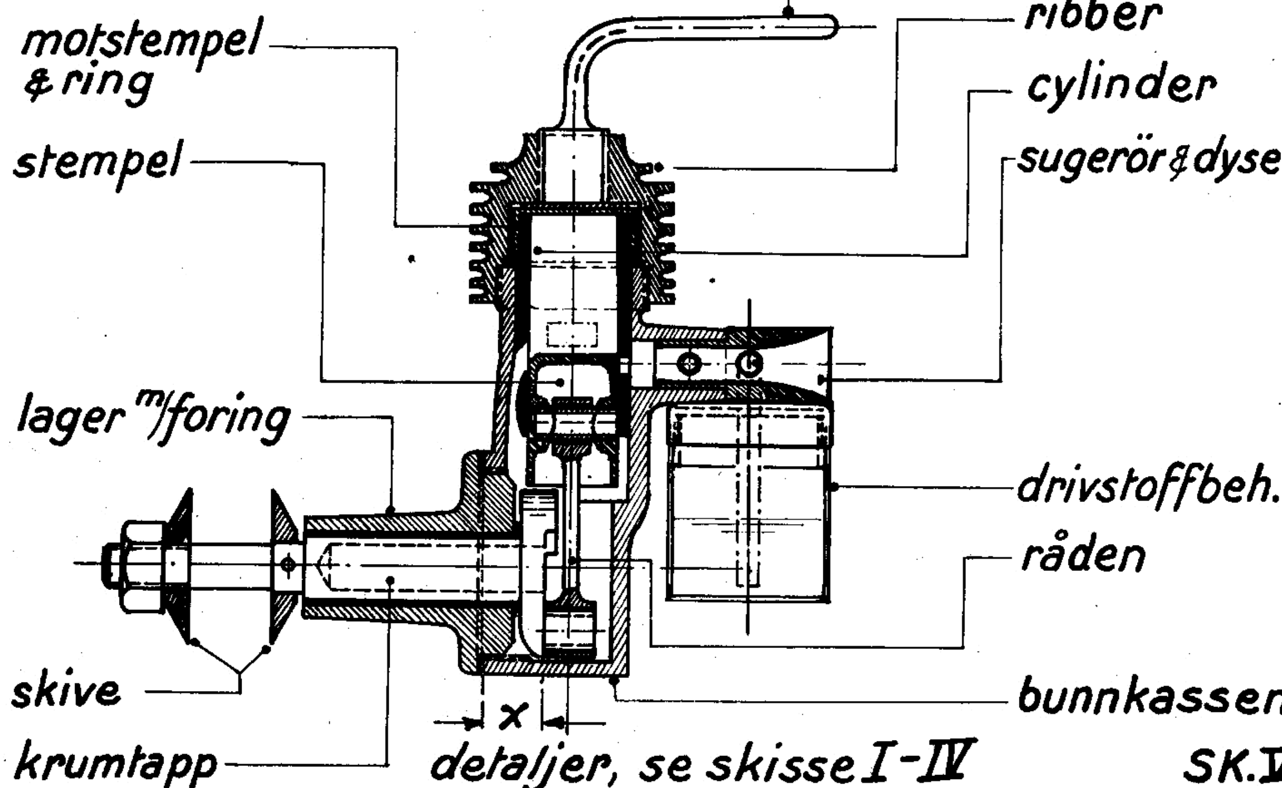
An engine with bad compression seal, i.e. leaking piston and/or contra piston, needs a higher compression ratio than an engine with good compression. The gas is simply ignited through the high temperature that is created by the compression of the gas. If the compression seal is good, the engine can be started on kerosene and oil. Once running, it can be run on diesel oil. If the compression seal is too bad it does not help to increase the compression ratio infinitely. In an engine with good compression seal, it should be possible to hold the compression for some minutes with the piston in its top position without any gas leaking past the piston or contra piston.

Data for diesel and petrol engines with approximately the same weight

	Diesel	Petrol	
Bore	13	19	mm
Stroke	18	17,5	mm
Volume	2,4	5	cm3
Speed	6000	7500	RPM
Power	0,083	0,143	HP
Prop diam.	300	280	mm
Torque	1,0	1,2	kgcm
Engine weight	150	150	gram
Tank	15	15	gram
Prop	35	25	gram
Total engine weight	**200**	**190**	gram
Battery		120	gram
Coil		65	gram
Capacitor and leads		25	gram
		210	gram
Total weight	**200**	**400**	gram
Weight/Power ratio	**2,2**	**2,8**	kg/HP

Sammenstilling av motor

Skala 1:1



SK.V

Building Instructions

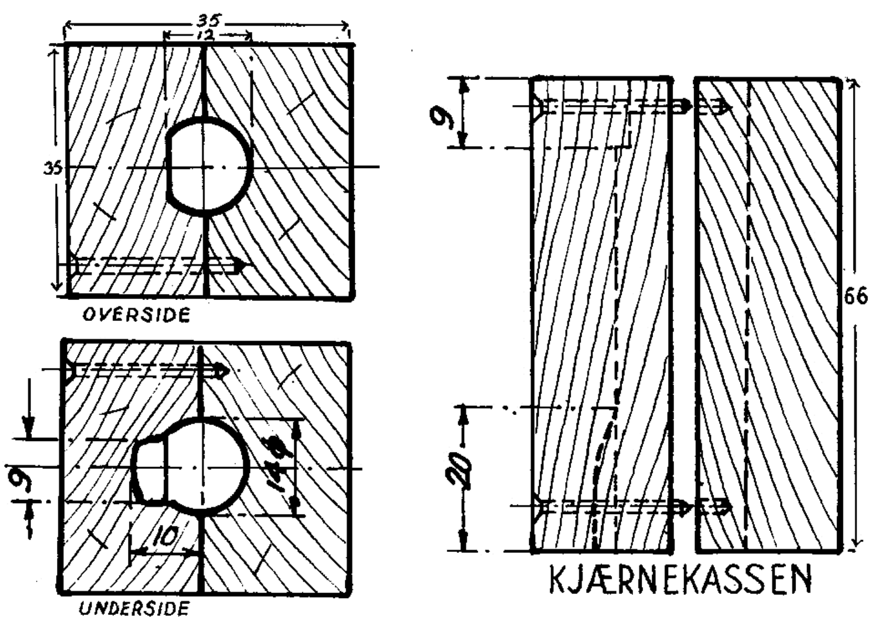
The work should be done in this order:

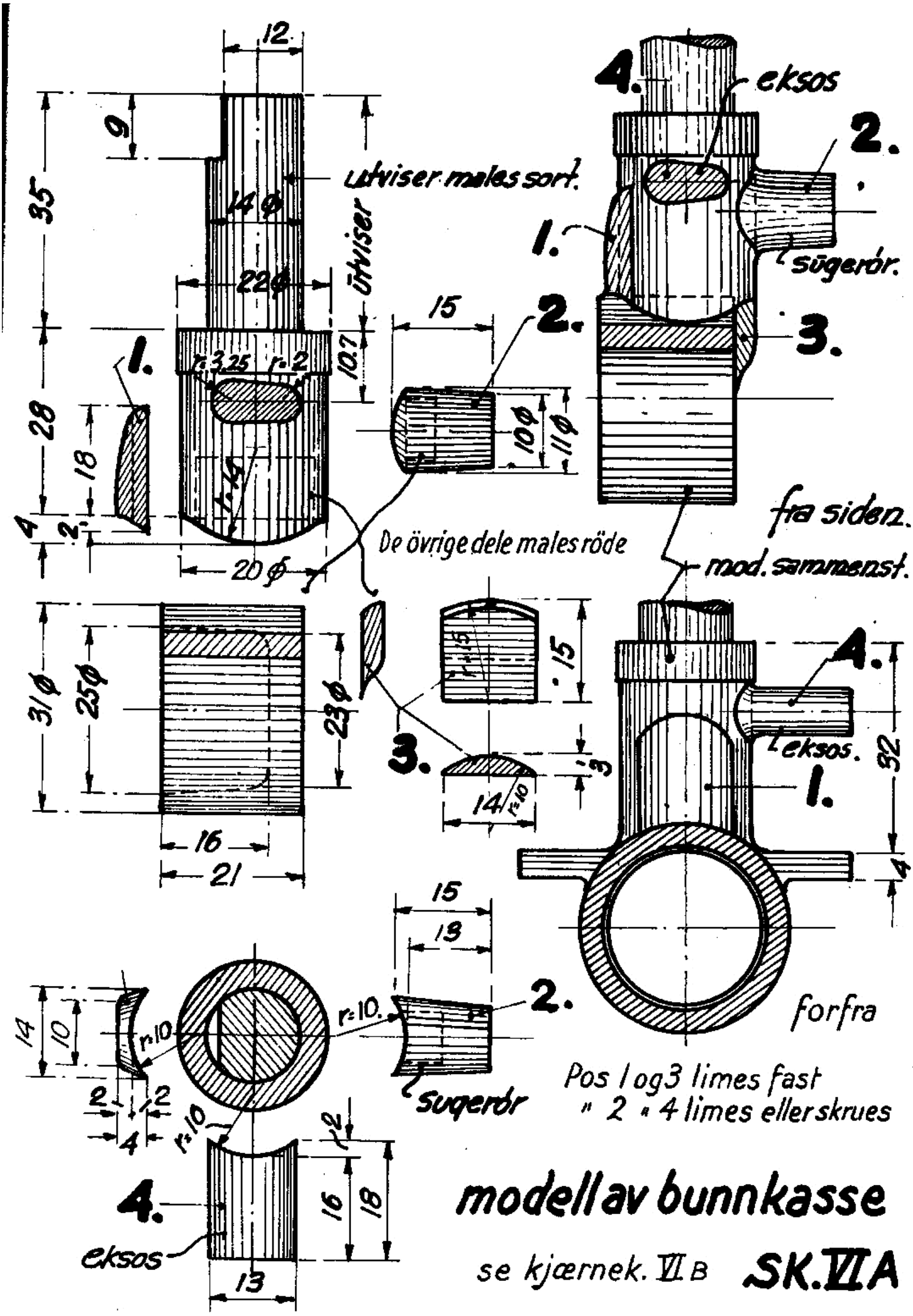
1. The pattern for the crankcase with core box
2. The crankshaft
3. The piston and the wrist pin (the piston coarse-turned)
4. The connecting rod
5. Finishing the cylinder externally
6. The crankcase
7. Fine-turning of the piston and honing
8. The contra-piston
9. Shrinking the cylinder into the crankcase
10. The main bearing and the bearing housing
11. The cooling fins

Parts not mentioned are turned when the list above is finished

The Crankcase

The crankcase pattern and the core box should be made of beech or birch or another kind of hard wood. Spruce and fir are not suitable. Exhaust and intake tubes are attached with screws. As can be seen in the drawing, all round parts that must fit together should be turned hollow in the ends so there will be less work with the cutting tool. All sharp angles should be filled with plastic wood to form suitable fillets. The intake tube should be conical in order to loosen easily from the mould.




utviser males sort.
ûtviser
De övrige dele males röde
eksos
sûgerör.
fra siden.
mod. sammenst.
eksos.
forfra
sugerör
eksos
Pos 1 og 3 limes fast
" 2 " 4 limes eller skrues
modell av bunnkasse
se kjærnek. VI B
SK. VI A

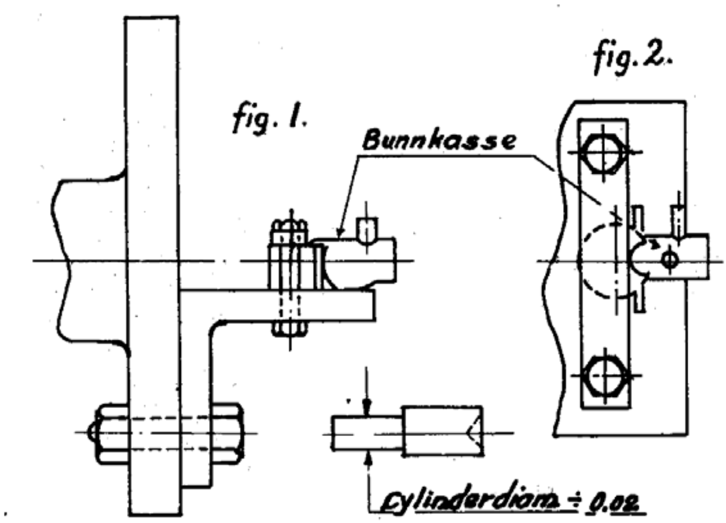
Finally the pattern is carefully painted so the sand won´t adhere to it.

The core box is made from two flat pieces of wood that are nailed together and centered on a clamping plate and then turned to the dimensions shown on the drawing.

When the turning is finished, the pieces are taken apart and the channel and the guide are made as good as possible, after which it is carefully painted. It is important that the guide is accurate so that the channel can be correctly mounted in the crankcase.

It is not worthwhile to do the casting yourself. A foundry will do the job for about 3 kr per piece. The crankcase is cast in aluminum or a copper-aluminum alloy that most of the foundries are using.

The crankcase is turned first. A four-jaw chuck will be good as a fixture. Then the intake tube can easily be turned, without



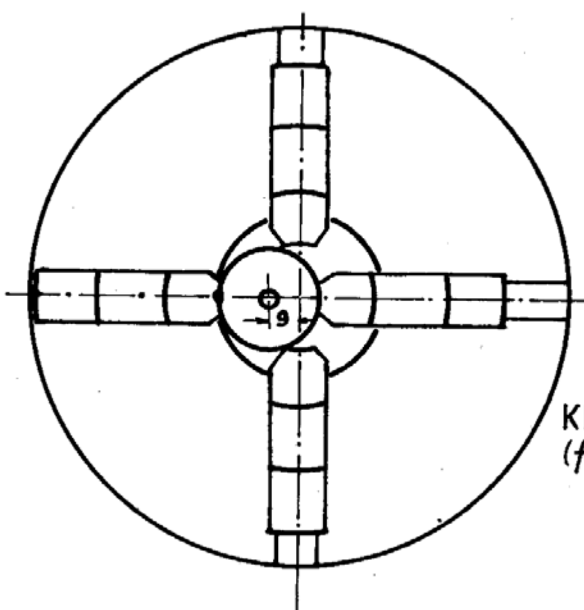
too much difficulty in workholding. It can of course be drilled out in a drilling machine, but the result will not be so accurate.

In order to bore out the space where the cylinder will be fitted, the crankcase has to be mounted on a 90 degree angle plate as shown in figure 1. When the measurement dowel, figure 2, can be fitted without using force, the tailstock centre is placed in the end of the dowel and the threads can then be carefully cut.

The exhaust stack is drilled out with a 3.5 mm and a 2 mm drill, the rest is filed out with a coarse needle file.

The bypass channel has to be matched to the cylinder, since it isn´t possible to make an absolutely perfect casting. With a thin sharp chisel, the superfluous material is removed and fine trimming is then easily carried out with a suitable needle file.

If you want to have a nice surface finish, the crankcase can be filed with a single cut file. Otherwise, aluminum is difficult to file without clogging the file. A piece of hard felt charged with emery paste can be used for final polishing.

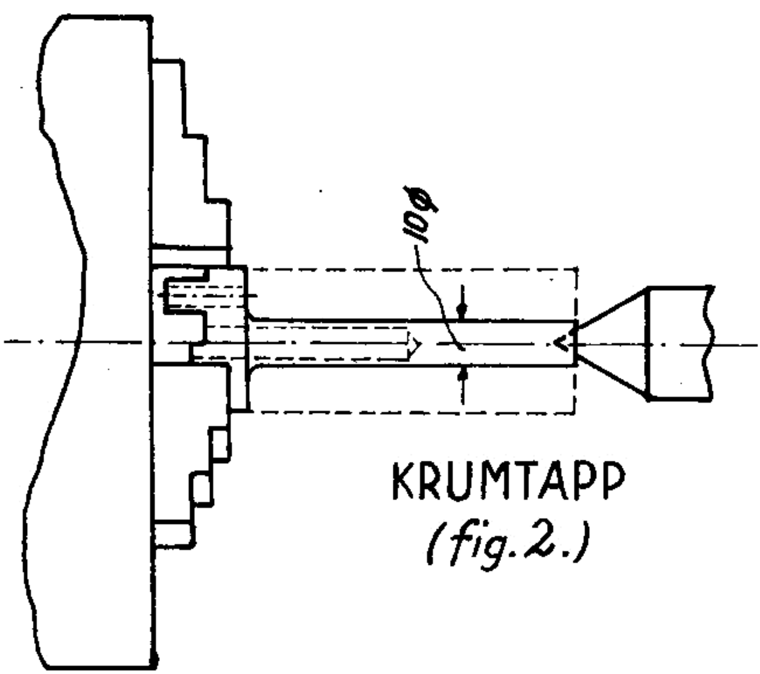


KRUMTAPP
(fig. 1.)

The crankshaft

The crank shaft should be made of Cr-Ni steel, S. N. C. 28 or S. N. C. 40 (Stavanger steel) to avoid hardening and grinding. Ordinary carbon steel is unsuitable because it is too weak when unhardened, and when hardened the shape may be distorted and it may become brittle. Oil-hardened steel is fine (S. N. S. or H. R. 119), but it has to be ground after hardening.

When the crankshaft is to be turned, it is good to start with a rod, 72 mm long and 20 mm diam. A crankshaft that is brazed together is not to be trusted in a diesel engine. It is not as much work to turn it from one piece as it may appear to be. In a good lathe, it will be coarse-turned in one hour. The time that could be saved by using the brazing method is not worth mentioning.



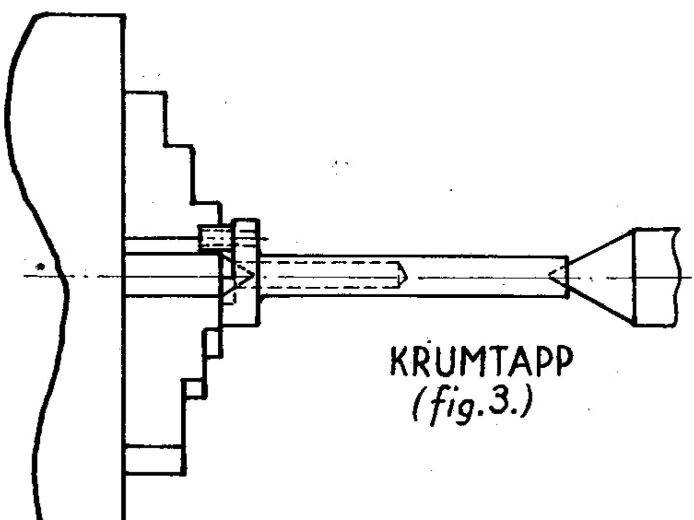
KRUMTAPP
(fig.2.)

First a center is carefully marked in one end of the rod, while in the other end a 7 mm hole is drilled as shown in the drawing. The center for the crankpin is marked with a punch mark and the rod is mounted eccentrically in a four-jaw chuck with the punch mark as the center (Fig. 1).

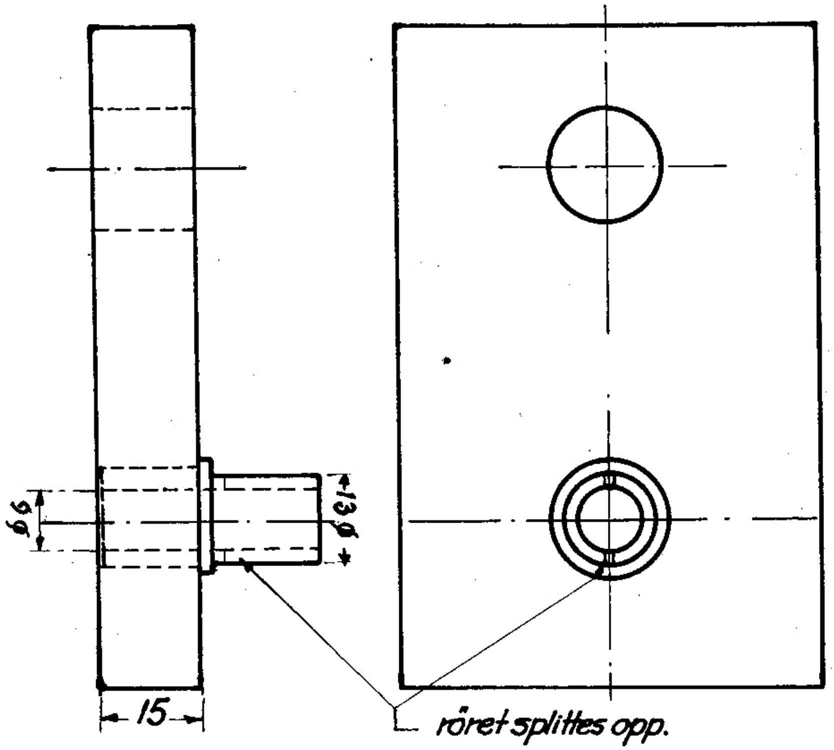
Now there are two possibilities: If you have a good four-jaw chuck and if you did the mounting carefully, the turning of this end of the crankshaft can be completed and it can be polished with emery cloth. If you want it absolutely perfect, it can be done as described later by turning the crank pin down to 0.3 mm over dimension.

The crankshaft is now taken out and turned around and mounted as shown in Fig 2. Here it is turned until the whole length is 10 mm in diameter. Then it is mounted between centers as in Fig 3. The small pin (crankpin) is used as a lathe dog between the jaws in the chuck.

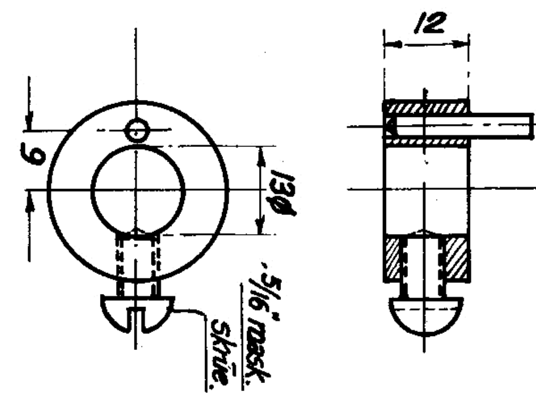
Now the crankshaft is fine-turned to its final dimension and then it is polished. If you have a 9 mm reamer, it is a good idea to turn the diameter of the crank shaft down to 0.01 – 0.02 mm less than 9 mm. Then it is just a matter of putting the reamer through the crankshaft bearing.



KRUMTAPP
(fig.3.)



SKALA 1:1



KRUMTAPP
(fig. 4.)

One has to be careful to ensure that the tailstock centre is properly positioned - if it is not, the bearing will acquire a conical shape. The bearing is turned until there is about 0.05 mm left; the rest is filed down and polished.

When you polish, the emery cloth must be placed under the file, and the file is then used in the usual way. If you move the emery cloth back and forth by hand, the result will always be uneven.

Before the superfluous material on the crankweb is removed, the crankshaft is mounted in the chuck and the threads are cut. The thread cutter should be guided with the aid of the tailstock. Now the crankweb is ground on an emery wheel, and finally it is smoothed with the help of a file.

The crank pin is turned to 0.3 mm over the nominal diameter. A tool is made as shown in figure 4. Two 13 mm holes are drilled in a 15 mm iron or metal plate. A piece of brass is driven into one of the holes and the plate is fixed to the plane plate with a screw through the other hole. A 9 mm hole is turned (not drilled) and the tube is divided.

An outside ring with a set screw and a screw inside the hole in the crank pin are holding the crankshaft when you are turning and polishing the shaft. It is difficult to polish because the crankweb is in the way, but with a good steel it will be possible to get a shiny surface with the help of piece of emery cloth which you can hold with your fingers.

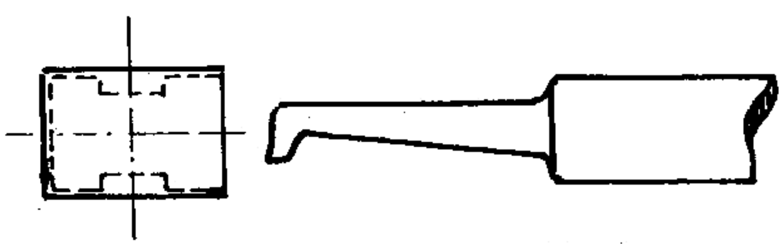
The advantage of this method is that the crankpin will always be parallel with the bearing, even if the centre isn´t accurately marked from the beginning. Whether or not the yaw plate is accurate is immaterial, and if more crankshafts are to be made a lot of marking-out work is saved and the stroke will automatically be the same length on all crankshafts.

The piston and the wrist pin

The piston is made of cast iron. It is turned with the open end free. A 7 mm hole is drilled and the hole is then made flat in the bottom with an 8 mm drill that has been ground flat in the end. The rest is turned out with a boring tool (fig 1). The outside diameter is turned to 0.3 mm oversize. In order to mark the position of the hole for the wrist pin, a thin line is turned in the lathe around the middle of the piston. A vernier caliper is placed on the piston as if you were to measure it. Then it is pulled along the piston, leaving lines along each side of the piston. Centre punch marks are made at the points where lines cross each other.

To get the lines more clear, the piston can be treated with copper vitriol before making the lines.

The piston is parted off when it is marked. Then it is put onto an 8 mm dowel, to make it easier to get good punch marks. The piston is placed in the lathe with a 4.8 mm drill in the chuck. One of the punch marks is centered on the drill, with the other punch mark being placed on the tailstock centre. Both wristpin holes are drilled in the same setup. After the holes are drilled to 4.8 mm they are finished with a 5 mm reamer.

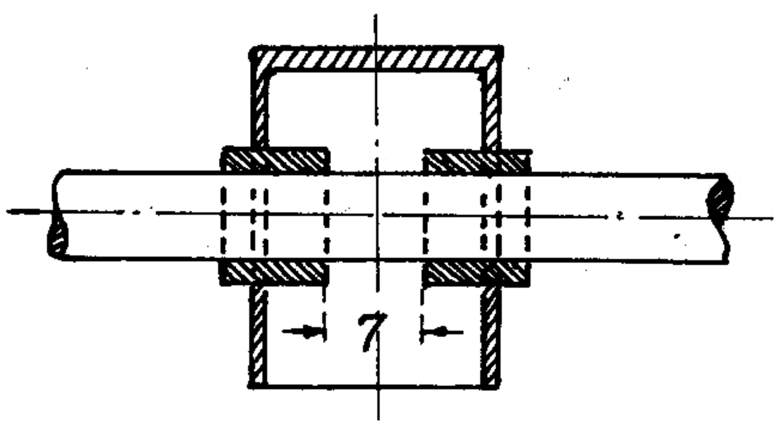


(fig.1.) 1:1

To make the piston as light as possible, it should be mounted eccentrically and the material between the holes should be turned away.

A method that is more frequently used is to turn the inside of the piston out fully and then braze the bearings for the wrist pin to the piston. The hole in the piston has then to be drilled to 7 mm, and the material in the piston wall is made 0.2 mm thicker. (Fig 2)

Before brazing the tubes, a rod is put through as a guide. The tube has to be made of steel. The wrist pin can be made of a piece of 5 mm silver steel that is drilled through with a 3.5 mm drill. The keeper, which is made of aluminum, should be located so the head is facing the intake channel. The head is then countersunk in the piston so that the wristpin cannot be lost in the bypass channel.

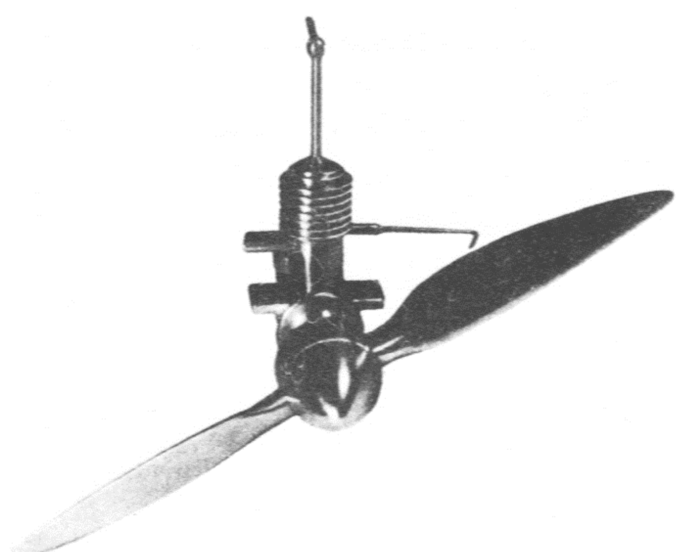


(fig.2.) SKALA 2:1

The Connecting Rod

The connecting rod is made of steel. Start with a piece, 39 x 7 x 8 mm. First the holes are marked, and then they are drilled in a drilling machine. A hand drill cannot be used. Drill first with a 3mm drill and then with 5.9 mm and 6.9 mm, and finally with 6 and 7 mm.

The bearings are made of a good quality bronze. The smallest bearing is turned first. When the outer diameter is finished, the connecting rod is pressed on to the bearing with the help of the tailstock and then the bearing is reamed to the inner diameter shown on the drawing, with the connecting rod still in place on the bearing. When the wrist pin fits, the bearing is cut as close as possible to the connecting rod and the rest is filed down. The same procedure is followed for the other bearing. Finally the shape of the connecting rod is marked and the superfluous material is ground off on an emery wheel.



The Cylinder

The cylinder is turned from cast iron. First, the outside diameter is turned to size, and then it is polished with an emery cloth until the turning grooves are gone. It is important that the outside is as round as possible to avoid the cylinder becoming distorted when shrunk into the crankcase.

The interior is turned as fine as possible till approximately 12.9 mm. 0.1 mm need to be removed by honing. During the honing work, it pays to have a thinner section at the upper end (Fig 1). This can be ground away once the honing is finished. It is impossible to avoid the cylinder becoming bell-mouthed at the ends. The lower end should be the widest, so the piston can easily enter.

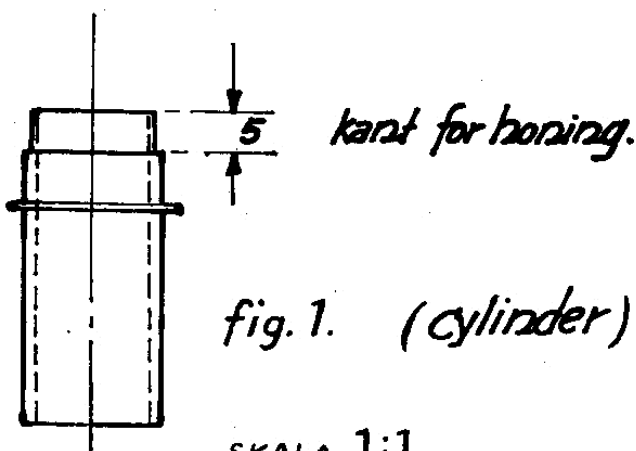
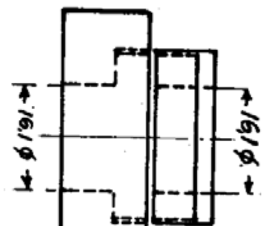


fig. 1. (cylinder)

SKALA 1:1

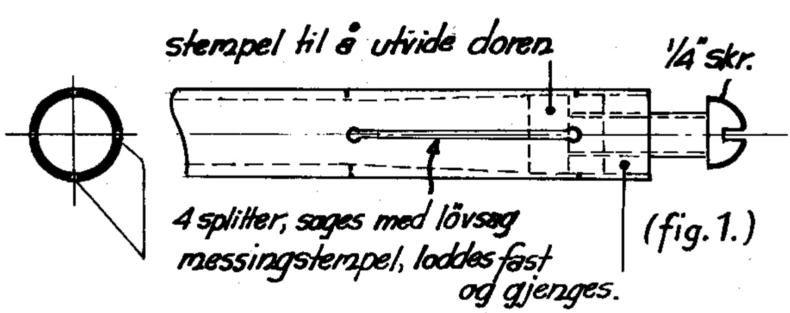
Fine-turning the piston and honing



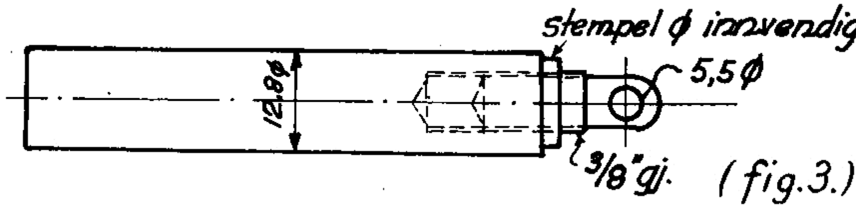
(fig 2)

The cylinder is honed before the ports are drilled out. For the honing, a copper rod is used, which is shown in Fig 1.

To hold the cylinder during the honing, a holder is made. (Fig 2) The holder is tightened so the cylinder can´t move in it. For polishing, diamantine is used, but this can be hard to find. Instead you can use abrasive powder mixed with thick oil. The lathe should be run at 300 – 400 rpm during the honing, and the cylinder is moved back and forth from side to side until the rod is not polishing any more. When the whole cylinder is evenly shiny, the honing is finished. Now the thin edge can be ground off and the ports can be added. They can be drilled with a hand drill and filed to shape with fine needle files. Please note that it is only the upper edge of the bypass channels that is important. It doesn´t matter if the lower edge is too low, the piston will always be above it. When the ports are finished, a little more honing is done to remove any burrs.



(fig.1.)

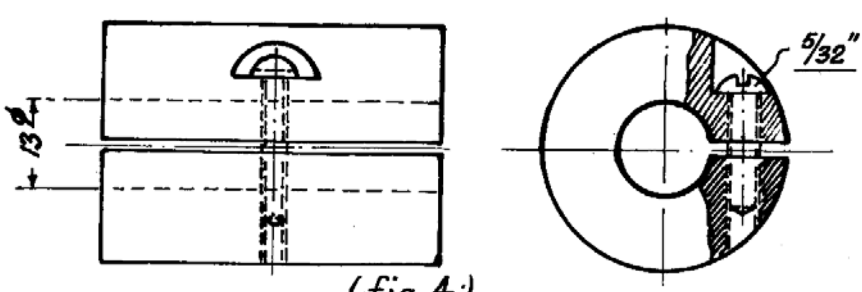


(fig.3.)

Now the piston is to be finished. First it is mounted on a mandrel (Fig 3). It is turned with a round sharp turning tool (small cuts). When there is about 0.02 mm left, the piston is externally honed with a tool (Fig 4) which is made from aluminum or preferably copper. Turn it around now and then, so it doesn´t acquire a skew. The piston should be honed so that it can enter the cylinder about 4 – 5 mm. Then the fine honing starts. For fine honing, emery is too coarse, but it can be used if this is done in the following manner. Emery powder and thick oil are mixed in a deep pot (*for better separation – Ed.*). Let the mixture rest for about 30 minutes so that the biggest grains have time to sink to the bottom. The top layer in the pot is then good for honing (*since it will have only the finest grains – Ed.*).

Now the piston and the cylinder are washed in petrol and the emery oil is brushed on to the piston. The lathe is started and the cylinder is gently pushed further and further in, while more emery oil is added. When the cylinder gets stuck, the whole thing has to be loosened from the mandrel, and the piston is knocked out with a piece of wood. The honing must be done with great care so the piston doesn´t get twisted to the point of fracture.

The honing is finished when the piston is easy to move when oiled, and has to be knocked through when dry.



(fig.4.)

The Contra-piston

The contra-piston is made up of two parts, as shown in the drawing: the piston itself which is made of aluminum or brass, and an outside ring of steel.

First the piston is turned. It should be a tight fit on the outside of the cylinder. The outside is made 1 degree conic so it can be adjusted later if it does not fit well at first.

The steel ring should be as good a fit as possible in the cylinder head and it should be turned 1 degree conic so it fits to the piston.

If the contra piston starts to leak, the steel ring can be pressed further down on the piston. (*Editor's note – this action will compress the brass or aluminium contra piston to restore its fit*). If it gets too tight, it can be pressed back again. Since the top of the contra piston is made of brass or aluminum, a steel plate has to be placed on top of it, so the compression screw does not dig in to the contra piston over time.

Shrinking

Before the cylinder is shrunk in, all swarf and dirt have to be completely washed away. The crankcase is put on an electric hotplate for about 20 minutes until it reaches about 250 deg C. The crankcase is then gripped with a pair of pliers and the cylinder is rapidly pressed down in to position. This has to be done very quickly, because it does not take many seconds before the cylinder is completely stuck. If the result is bad the whole lot can be heated up to 400 deg C. Then the cylinder can be moved into the correct position, or it can be taken out. I have shrunk about 10 engines this way and I always got good results.

The coefficient of expansion for aluminum is 0,000024, so the clearance at 200 deg C will be about 0.05 mm.

Bearing and bearing housing

If you don´t already have a bar of aluminum alloy (pure aluminum is too soft) you should send a bar of wood (or any other material), about 34 mm diameter and 150 mm in length together with the crankcase and have it cast.

The bearing is turned first. Start with the outside and then drill the inside with an 8 mm drill. If the bearing is turned to the final internal measurement before it is pressed into the housing, it will usually become too tight when pressed in.

The bearing is pressed into the bearing housing with help of the tailstock, and the inside is then turned.

If the crankshaft has been turned earlier with the reamer as a diameter reference, the bearing is turned until 0.1 mm is left, then the reamer is carefully put through.

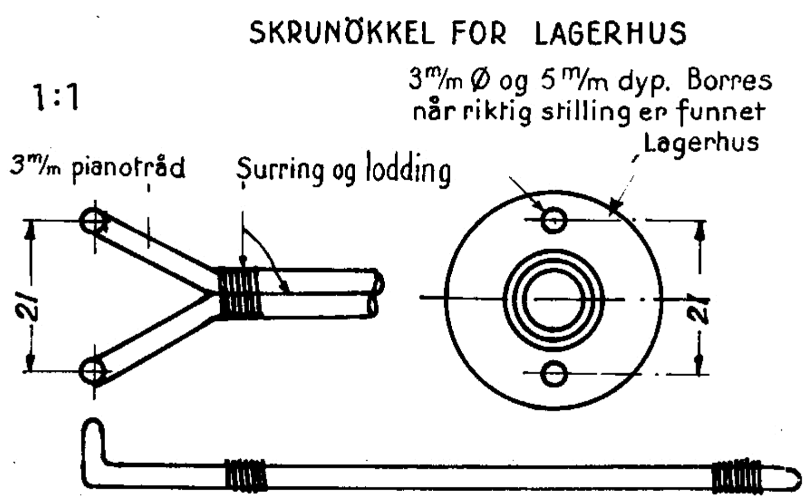
Before the crankcase is turned, the piston with the connecting rod should be put in the engine and a control measurement should be taken between the front surface of the crankcase and the edge of the connecting rod, marked X on the drawing on page 10. The threaded length on the bearing housing (5.5 mm on the drawing) will then be X minus 4 mm (that is the 3.5 mm thickness of the crank pin + the 0.5 mm edge of the bearing 0.5 mm). The gasket should be around 0.3 mm thick.

The bearing housing is placed in the lathe in a way that makes it possible to test the threads on the crankcase.

The threads should be cut so that they tend to tighten up when the engine runs. Most people prefer LH threads, but the engine runs equally well in both directions.

Cooling Fins

The cylinder head is made of a piece of the same casting that was used for the crankshaft bearing housing. The fins are cut with a 2 mm thick cut-off tool with nicely rounded corners. The inside should fit as closely as possible over the contra-piston in order to provide good cooling. The transition between the top and the sides must be turned with a little fillet to avoid cracks. When the threads in the hole for the compression screw are to be cut, the cylinder head is screwed on to the engine and the thread tap can be screwed through while the crankcase is carefully held in a vice.



Assembly

Before assembly, all parts must be washed in petrol. The connecting rod is mounted in the piston, which is brushed with oil and pushed down into the cylinder. The crank pin is put into the end of the connecting rod. The bearing housing is screwed into the crankcase without a gasket. If the connecting rod gets bent by the crankshaft, the bearing housing is unscrewed a little until the crankshaft has an axial play of about 0.3 – 0.4 mm. This position is marked, after which one tests different gaskets until one is found that makes the bearing housing stop in this position. If there is a lot of play when the bearing housing is screwed in without a gasket, it can be cured by careful filing of the crank case, or even better, you can put the crankcase in the lathe and turn it a little. When the correct position is found, material is filed away for the bypass channel and the lubrication hole is drilled. The rest of the parts are mounted, and the engine is now ready for test running.

The propeller

To achieve a good result, it is important that the propeller is as well matched as possible. Both the engine´s power output and the airplane's climbing performance are dependent upon the propeller. For diesel engines, larger propellers are used compared to petrol engines, due to the diesel´s lower rpm. This is a great advantage since it increases the propeller´s efficiency. The diameter of the propeller for this engine should be between 28 and 32 cm, depending on the size and weight of the model airplane. A suitable plane for this engine will have a wingspan between 110 and 150 cm. The weight will then be between 450 and 650 gram. The weight of the propeller should be 20 – 25 gram. With a lighter propeller the rotating momentum will be too small. An aluminum propeller will give the best result, but the danger of cutting your fingers must not be overlooked. It is recommended that beginners use a wooden propeller. Birch, hickory and other heavy kinds of wood will be good for making propellers. Oak is not so good because it splinters easily.

By measuring the power output with different propellers it has been shown that it should be between 28 and 32 cm. The calculation of which would be the proper propeller to chose is so difficult that it cannot be done by an amateur. The easiest way to get it right is simply to test different propellers in the range that has been mentioned.

The width of the blade is always made 1/10 of the diameter.

To find the pitch, you can proceed in the following way: An aircraft with a wing loading of 25 gram/dm2 will fly with a speed of approximately 36 km/h. If we assume that slip efficiency is 75%, the pitch is defined.

75% = 36 km/h = 10 m/s - the speed of the aircraft

100 % = 13 m/s - the speed of the aircraft in relation to the propeller slipstream

The engine speed = 100 revolutions per second

Pitch = the distance that the propeller moves forward for one revolution with no slippage

Pitch = 100 x 13/100 = 13 cm

To achieve the proper pitch, the following is the most commonly used procedure:

The front view of the propeller is drawn, Fig 1

Of the side view, only the center and the front edge (a straight line) can be drawn, Fig 2

To find the points that the rear edge should pass through, a drawing is made like Fig 3.

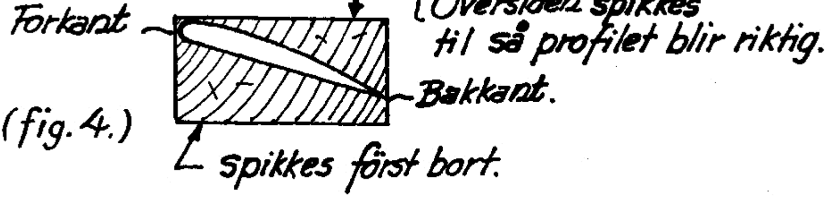
The pitch divided by 6.28 is marked as ordinate, and the radius in the point where the height shall be found, as abscissa. The end points of the lines are connected. The angle at the end point of the radius (point 10 in the Figure) is the angle that the blade should have 10 cm from the middle.

The width of the blade (A B) is marked and the height (h) is known. Now the same thing can be done for as many points as you wish. In the figure, the heights are found at these points: 4 – 6 – 8 – 10 – 12 – 14, and the trailing edge is drawn.

Figure 1 is drawn on the material, and the material is shaped with a knife. The side view is drawn on the material and the rear side is shaped with a knife, Figure 4.

How to proceed is shown in the Figure. The thickness of the profile should be 13 – 14 % of the blade width.

To get the best possible result, the propeller should always be sanded and balanced very carefully. It should then be lacquered to protect the wood.



(fig. 4.)

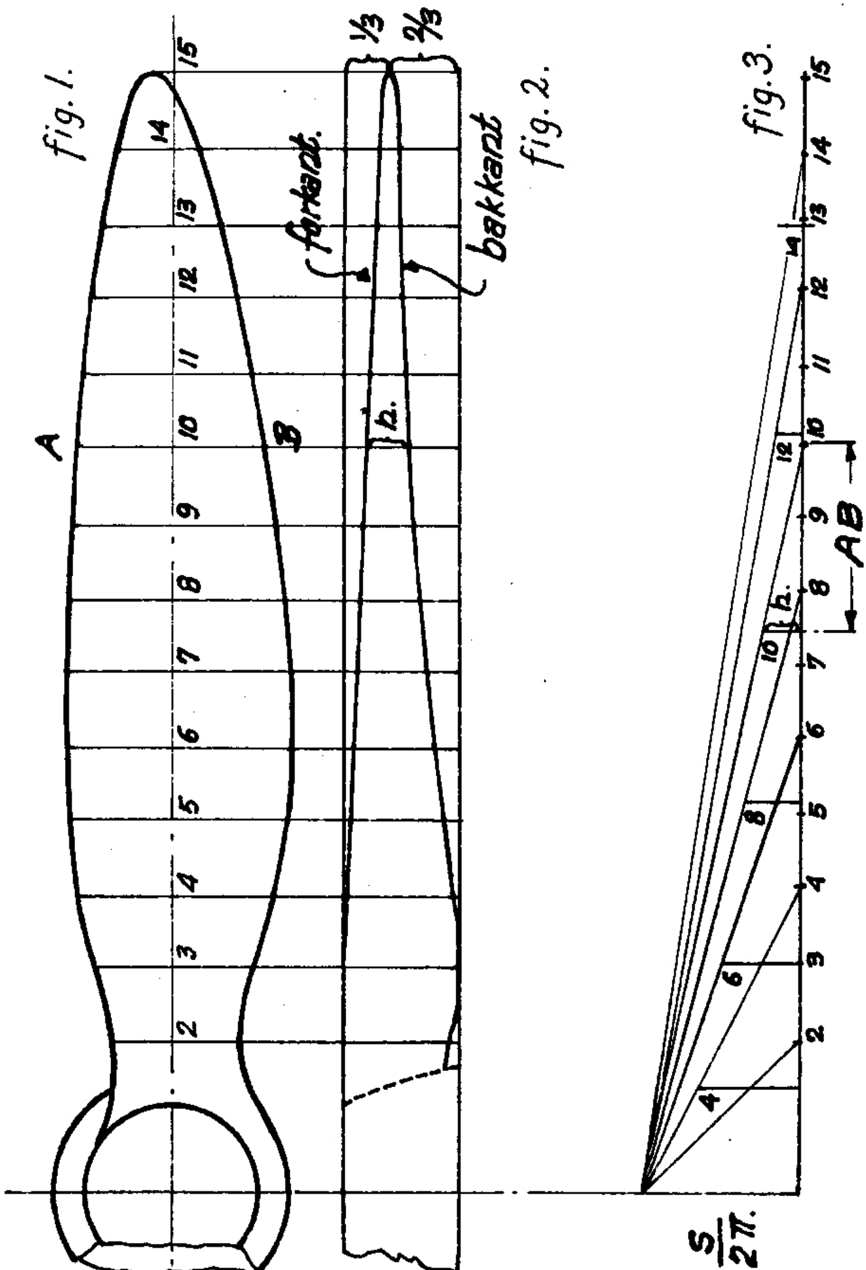


fig. 1.
A
B
fig. 2.
forkant.
bakkant
1/3
2/3
h.
fig. 3.
AB
h.
$\frac{S}{2\pi}$

Fuel

The usual mixture for these engines is 2 parts white spirit (paraffin), I part naphtha and 1 part oil. The oil should be as thick as possible, preferably SAE 70. Do not use gearbox oil. Petrol, diesel fuel and paraffin can also be used. The mixture ratio should never be more than 1 part oil and 5 parts of fuel, or the engine will be worn out in a short time.

Starting the engine

Starting a new engine is usually difficult. 2 – 3 hours of flipping is not unusual. The engine is raw, the setting of the needle valve and the compression screw are unknown. All this will make it take a long time, but once started and run for a while, it will be easy to start again. Once you know your diesel and it is broken in, it seldom takes more than one minute to start it. When the engine is to be started, it always has to be choked. This is done by blocking the carburetor inlet with your finger. The compression screw should be adjusted so that the distance between the piston and the contra piston is around 1 mm. This can easily be measured in advance.

The needle valve is completely closed, and then it is gradually opened while you keep flipping the propeller. When your finger is wetted by the fuel mixture, leave the needle in that position. Continue the flipping and block the intake with your finger now and then. If the engine doesn´t fire, the compression screw is screwed downwards. If it still doesn´t fire, you can put a drop of naphtha into the exhaust tube. To begin with, the engine will only run for about 2 – 3 seconds at a time. By trying different settings of the needle valve and compression screw, the engine will successively run for longer and longer periods until finally it will run continuously.

Breaking in

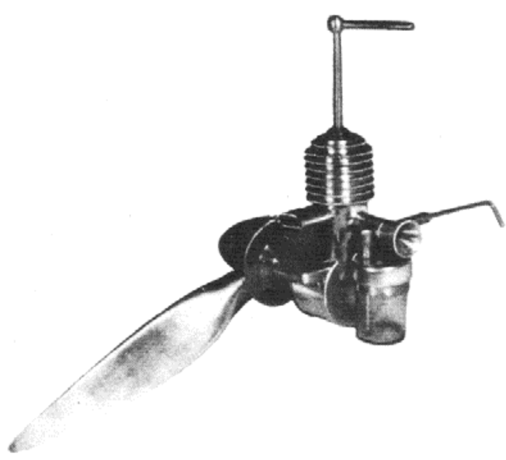
In the beginning, the engine is run slowly (low compression) with a mixture consisting of:

1 part white spirit, 1 part naphtha, 1 part oil, or:

2 parts naphtha, 1 part oil

It is run with as little compression as possible for half an hour. Then, when it is broken in, it may be tested at full speed. When the compression is increased, the needle valve has to be closed a little, and vice versa.

To determine the best setting, the needle is screwed in until the running starts to be erratic. The compression is increased until we again can hear that the engine runs nicely. Thus the needle valve is progressively closed as much as possible.



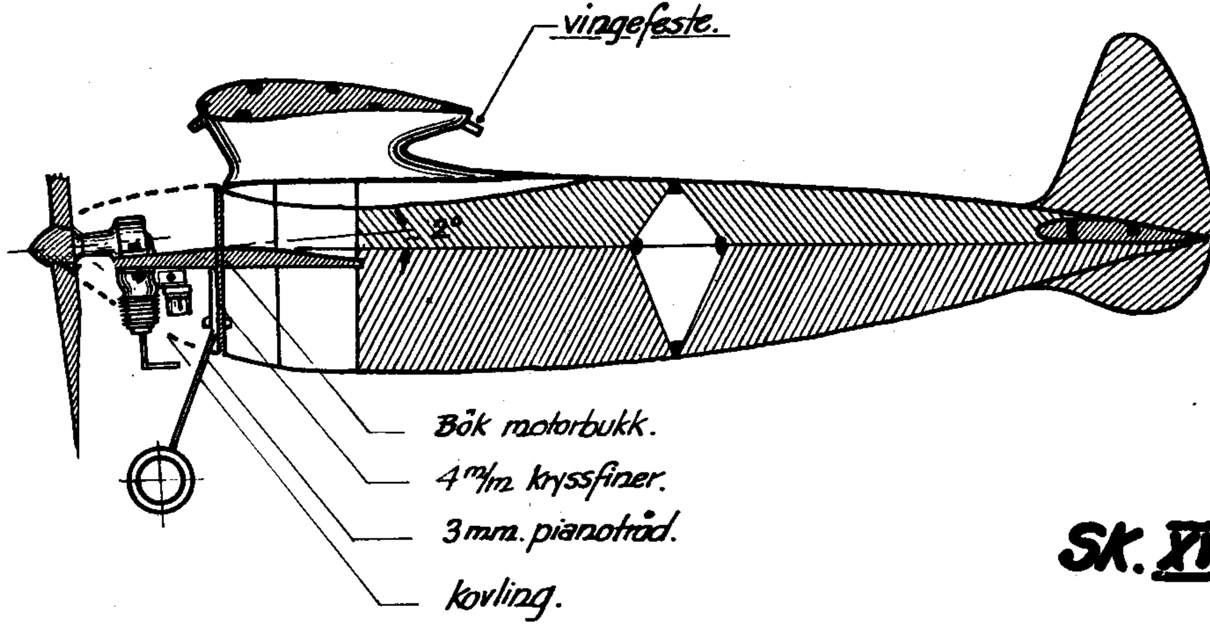
Mounting and use of the engine

The engine bearers are made of hard wood, beech, birch, ash and so on. Multi cylinder engines often have a flexible suspension, but this cannot be done with a single cylinder engine. It should be mounted as rigidly as possible, or else there will be vibration which will cause bad running or stop the engine completely.

The engine is mounted on the test bed such that there is ample space for choking the engine with your finger. The arm on the compression screw should be pointing backwards when the engine is running normally, in order to get your fingers as far away from the propeller as possible. This can be adjusted by putting a thin metal plate on top of the contra piston, or you can file down the compression screw a little. The fuel tank should be mounted to the engine, but if there isn´t space enough for this, a celluloid tank can be glued to the aircraft, with a synthetic rubber hose to the spraybar.

If the engine is to be used in a boat or in a car, room has to be created for a flywheel. It will be approximately 50 mm diameter and 20 mm thick.

A suitable speed-boat for this engine would be about 500 mm long and the width about 1/3 to 1/3.5 of the length.



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